



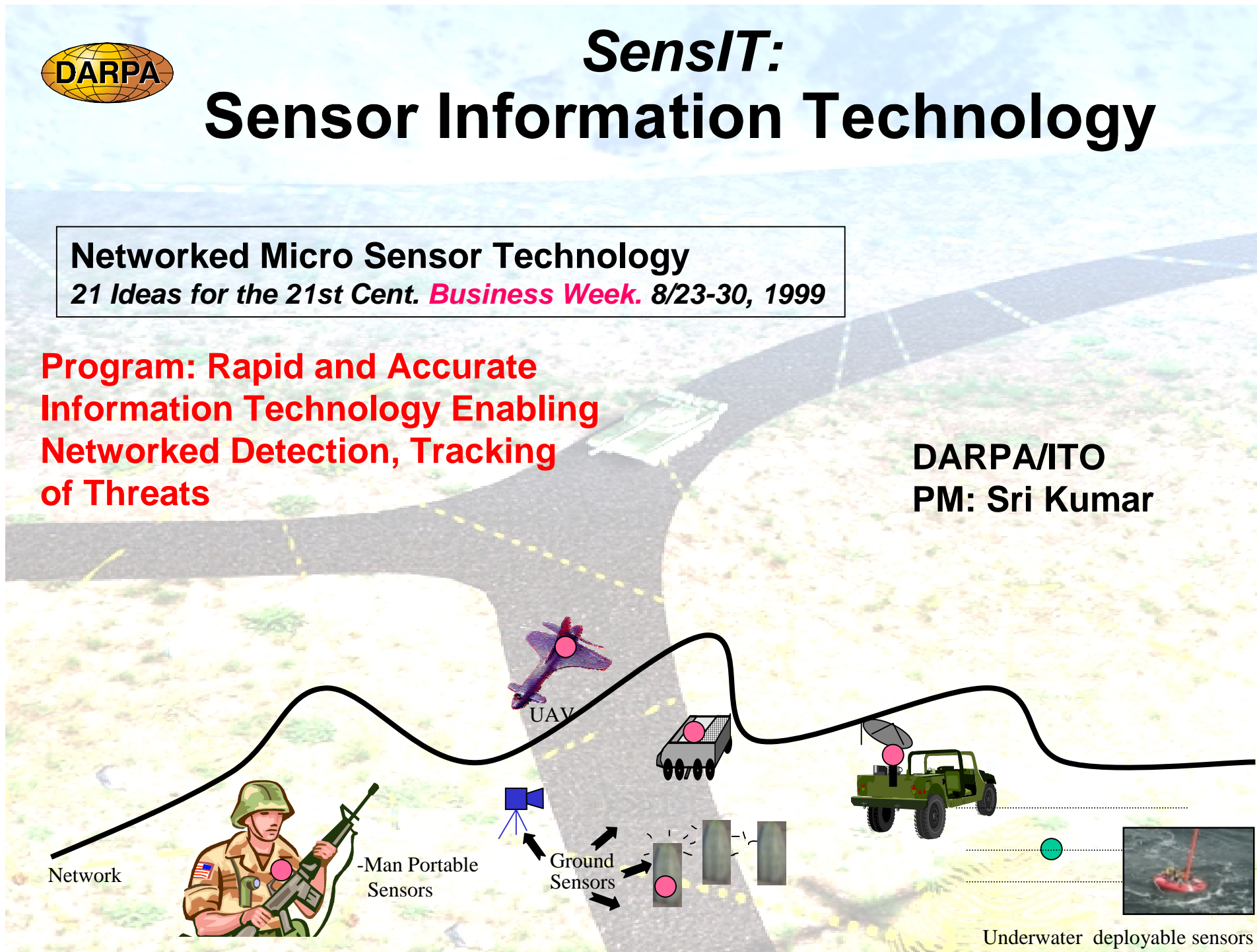
SensIT: Sensor Information Technology

Networked Micro Sensor Technology

21 Ideas for the 21st Cent. *Business Week*. 8/23-30, 1999

**Program: Rapid and Accurate
Information Technology Enabling
Networked Detection, Tracking
of Threats**

DARPA/ITO
PM: Sri Kumar





Sensor Information Technology

Goal

Software for distributed Micro Sensor Networks

Thrusts

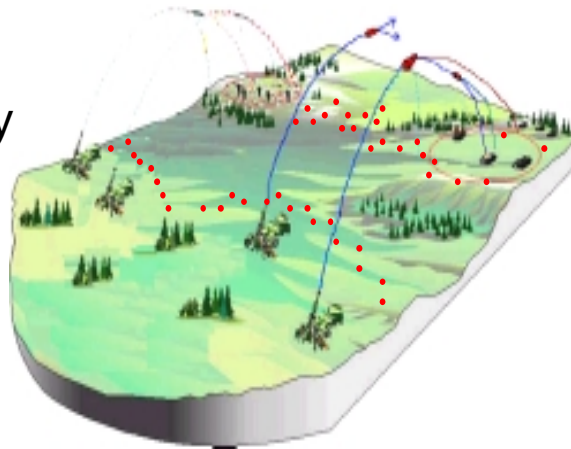
- New networking methods
- Leverage distributed computing paradigm for
 - Reliable extraction of right and timely information from sensor field
 - Networked signal and information processing
 - Dynamic querying and tasking



Software Supporting New Capabilities

System Parameters

- Latency
- Energy
- Autonomy
- Survivability



For Networked Micro-Sensors

- Interactive
- Programmable
- Multi-Tasked
- Short Range
- Algorithms to exploit proximity of devices near threats
 - drastically improved S/N
 - exploit multi-modal sensors
 - collaborative processing

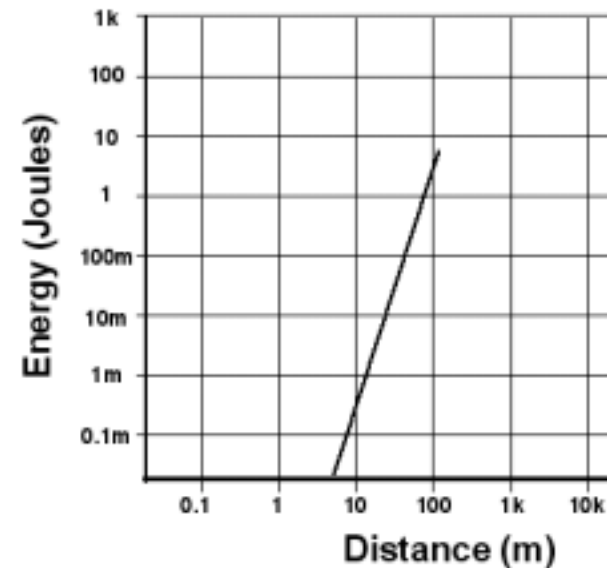
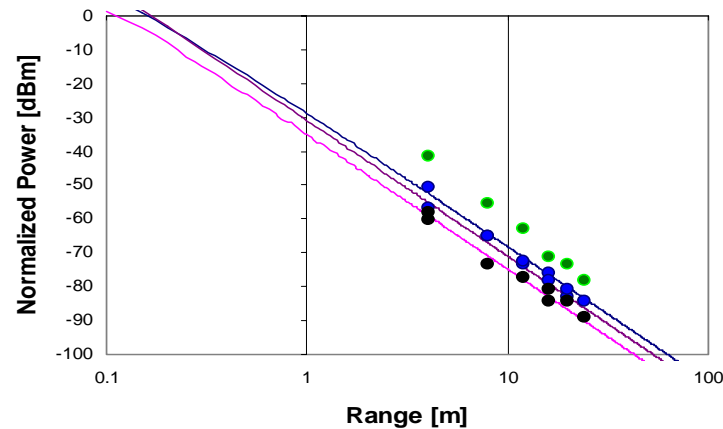
Low-Cost, Rapid, and Accurate:

- Detection
- Identification
- Tracking
- Targeting
- Communication to overhead asset



Environment

- ◆ Operating Conditions
 - Harsh, Uncertain, Dynamic: Adaptive
 - Autonomous Operation
 - Scale: Too many devices for manual configuration
- ◆ Dynamic availability of resources
 - Energy/Power, BW, MIPS Constraints





Challenges

◆ Networking

- Reliable, Survivable, Secure
- For Ad-Hoc, Rapidly Deployable Devices
- Seamless Fixed/Mobile Device Interaction

◆ Networked Computing

- Extract Useful Information from Sensor Field
- Collaborative Processing
- Dynamic Query, Tasking
- Reliable and Efficient



SensIT: Tasks

- ◆ Networking
- ◆ Collaborative Signal Processing
- ◆ Query/Tasking
- ◆ Software Integration/Experimentation



Networking: Fixed Sensor Devices

Characteristics:

- Ad-hoc, self-assembled
 - minimal state; IP-alternative
- Low-latency
- Survivable, secure



New Approaches:

- No IP-address
 - No global topology
- Data-centric vs. end-end connections
- Application specific
- Survivability, adaptation through redundancy
- Diffusion routing

Tradeoffs:

- Latency
- Reliability
- Power/Energy?

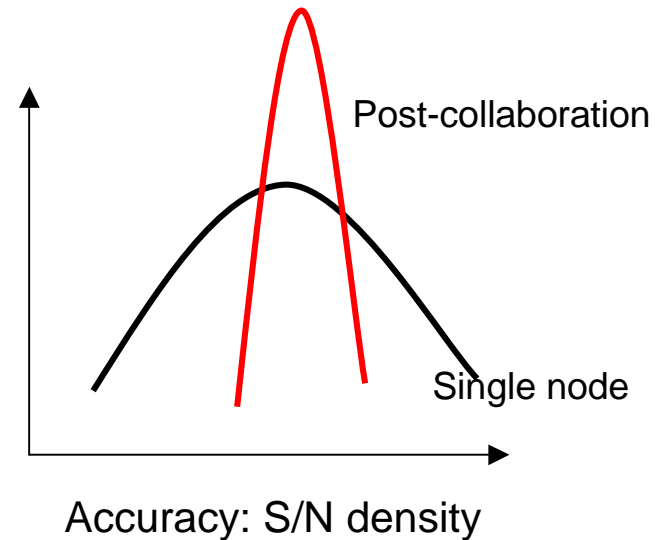
Deployment Density/Size?

- Scaling effects



Collaborative Information Processing

- ◆ Exploit Dense Spatial Sampling
 - Networked Consensus
- ◆ Distributed Signal Processing Algorithms
 - Asynchronous
 - Progressive Accuracy
 - Efficient: Energy, BW, MIPs
- ◆ Deployment Density
 - Performance
 - How does it scale?





Querying and Tasking

- ◆ Simple User Interface
 - Query/Tasking Language
- ◆ Query/Task Processing
 - Distributed; Multi-tasking
- ◆ Distributed Micro Database
 - Data Organization
 - Placement and Caching
 - Scalable
- ◆ Capacity

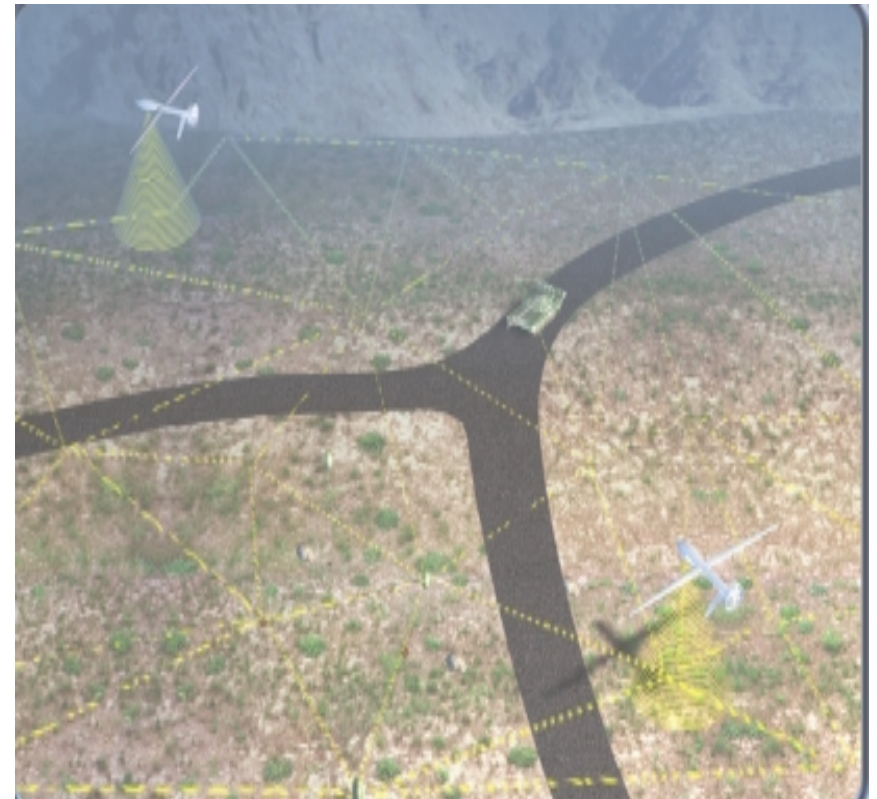




Fixed/Mobile – Internetworking

- ◆ Discovery (Identity, Services)
- ◆ Engagement (Fixed/Mobile)
 - Single Point/Multi-Point
 - **Handoffs**
 - Depth of Engagement
 - **Edge**
 - **Deeper**
 - Planned and Ad-hoc
 - Intermittent Connectivity
- ◆ Leveraging Mobility
 - Cueing; Fill Holes
 - When and Where;
Task/Code Migration

Mobile Sensors, Mobile Query





Experiments: Field, Lab





SensIT: Impact

◆ Function

- Detection
- Identification
- Location
- Tracking

◆ Targets

- Personnel
- Wheeled/Wing
- Tracked

◆ Environment

- Open field
- MOUT

◆ Users

- Dismounted soldiers
- Command post
- Force level
- Intelligence

◆ Application

- Personal
- Platoon
- Battalion
- Border and base security
- Air campaign
- Land mine replacement

**Embedded IT Enabling Revolution
in Networked Sensing**